IEM's AI Modeling: Short-term COVID-19 Projections

Date: 1/4/21

Leveraging over 15 years of support to HHS for medical consequence modeling and our proprietary artificial intelligence (AI) models, IEM believes that our Coronavirus model outputs can be used to assist localities and their medical facilities to better prepare for an increase in hospitalizations, to better plan for and locate drive-through testing facilities, and to determine where increased levels of transmission may be occurring.

We have been refining our AI model over the past month and are confident in its ability to provide accurate 7-day projections that can be used for operational and logistical planning.

AI-based Model Background

IEM is currently using an AI model to fit data from various sources and project new cases of COVID-19. We do not assume the average number of secondary infections (R-value) stays the same over time. IEM's AI model finds the best R-value over time to evaluate how it changes over the course of the outbreak. The IEM modeling team is running ~11 million simulations to fit each state's data and using the best fit for the R-value to project new cases over the next 7 days. The AI models are executed on a daily basis to evaluate the changing dynamics of the COVID-19 pandemic. Our projections have typically been within 10%, and are often within 5%, of actual confirmed cases.

The projections shown in this document are based on data pulled in as of 1/4/21 9 a.m.

Please provide any feedback or send any questions that you might have to us. We are continually updating and improving the model, so your feedback is critical.

Also, if you have more current or refined data for your State, Commonwealth or Territory that you would like IEM to factor in, please let us know.

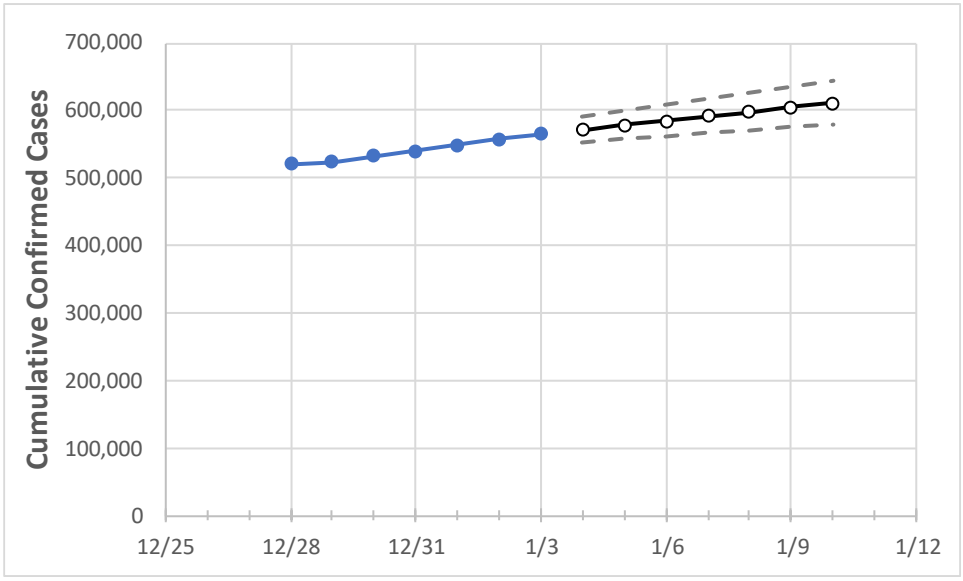
IEM's Modeling Lead

Dr. Prasith "Sid" Baccam is a **Computational Epidemiologist expert** at IEM with more than **20 years of experience in medical consequence modeling and simulation of disease outbreaks** and medical consequences following hypothetical attacks with biological agents or emerging infectious diseases. He develops key simulation models and decision support tools at IEM, specializing in public health, disaster response, and medical countermeasures (MCM) to enhance data-driven decision making and improve modeling assumptions.

Upon receiving his **Ph.D. in Applied Mathematics and Immunobiology** at Iowa State University, Dr. Baccam worked as a Postdoctoral Research Associate at Los Alamos National Laboratory where he focused on researching viral and immunological modeling. After his stint at Los Alamos, Dr. Baccam has served as Task Lead in multiple public health projects have allowed him to develop expertise as a mathematical biologist and a leader on high-performance modeling and simulation teams.

He has worked with state and local public health officials as well as Federal agencies, including **HHS**, the Centers for Disease Control and Prevention (**CDC**), and the Department of Homeland Security (**DHS**). Dr. Baccam has published numerous papers on public health response models and implications on policy and has been invited to participate in workshops and symposiums held by the Institute of Medicine (now the National Academy of Health). His modeling results have been briefed to the **Executive Office of the President** and informed two presidential policy actions.

North Carolina State Projections



	Actual Confirmed Cases On:				Projected Cases For:						
	12/31	1/1	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	1/10
North Carolina	539,545	548,991	558,437	564,924	571,465	577,949	584,536	591,214	597,924	604,623	611,292

Note: The State's projection shows a "best estimate" curve (the solid line with circles) and the dotted lines are the upper and lower estimates around that best estimate. Our projections have typically been within 10%, and are often within 5%, of actual confirmed cases.

North Carolina Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	12/31	1/1	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	1/10
Cumberland	13,900	14,112	14,324	14,430	14,579	14,728	14,874	15,024	15,181	15,336	15,488
Durham	14,811	14,998	15,184	15,279	15,406	15,534	15,663	15,795	15,925	16,056	16,189
Guilford	24,500	24,973	25,445	25,761	26,051	26,343	26,631	26,921	27,225	27,530	27,832
Mecklenburg	62,454	63,448	64,442	65,134	65,817	66,520	67,218	67,917	68,639	69,357	70,094
Orange	5,046	5,119	5,192	5,227	5,273	5,320	5,368	5,417	5,466	5,514	5,567
Union	12,505	12,772	13,039	13,215	13,418	13,629	13,844	14,059	14,280	14,504	14,733
Wake	44,059	44,507	44,954	45,725	46,311	46,911	47,523	48,143	48,771	49,430	50,093

Some recipients of our daily COVID-19 short-term (7 day) projections have requested projections of demand for: hospital bed, intensive care unit (ICU) beds, and mechanical ventilation. We realize that different states and localities will have different characteristics for hospital demand of COVID-19 cases, and we are presenting the best assumptions we could find for those medical demands based on scientific literature and health data reporting. Specifically:

- *Beds: For hospitalization, we use a range of 10% and 20% of cases require hospitalization based on CDC's report (MMWR, March 18, 2020) and state reports of COVID-19 cases.*
- *ICU: The CDC report found that 24% of hospitalized cases require ICU care.*
- *Ventilators: Based on clinical data from China and state reports, we assume that 50% of ICU cases require a ventilator.*

If you have other estimates for these assumptions, please share them with us as we work to refine our modeling, assumptions, and data on a daily basis.

*The medical demands shown in the table assume 20% of **cumulative** confirmed cases require hospitalization. To get the medical demand for the assumption that 10% of confirmed cases require hospitalization, simply divide the demand by 2.*

North Carolina Medical Demands by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:		
	12/31	1/1	1/2	1/3	1/5	1/7	1/9
Cumberland	13,900	14,112	14,324	14,430	14,728 (2,946) [707] {353}	15,024 (3,005) [721] {361}	15,336 (3,067) [736] {368}
Durham	14,811	14,998	15,184	15,279	15,534 (3,107) [746] {373}	15,795 (3,159) [758] {379}	16,056 (3,211) [771] {385}
Guilford	24,500	24,973	25,445	25,761	26,343 (5,269) [1,264] {632}	26,921 (5,384) [1,292] {646}	27,530 (5,506) [1,321] {661}
Mecklenburg	62,454	63,448	64,442	65,134	66,520 (13,304) [3,193] {1,596}	67,917 (13,583) [3,260] {1,630}	69,357 (13,871) [3,329] {1,665}
Orange	5,046	5,119	5,192	5,227	5,320 (1,064) [255] {128}	5,417 (1,083) [260] {130}	5,514 (1,103) [265] {132}
Union	12,505	12,772	13,039	13,215	13,629 (2,726) [654] {327}	14,059 (2,812) [675] {337}	14,504 (2,901) [696] {348}
Wake	44,059	44,507	44,954	45,725	46,911 (9,382) [2,252] {1,126}	48,143 (9,629) [2,311] {1,155}	49,430 (9,886) [2,373] {1,186}

For additional information from IEM, please contact Bryan Koon, Vice President of Emergency Management and Homeland Security at bryan.koon@iem.com or 850-519-7966 or Stephanie Tennyson at stephanie.tennyson@iem.com or 202-309-4257.